

Announcements

□ Homework for tomorrow...

Ch. 26, Probs. 40 & 50

Ch. 27, Probs. 24 & 26

CQ7: a. 10 b. 1

CQ8: 2nC/cm^2

26.12: a) 0 b) $4,100\text{ N/C}$

26.14: a) 0 b) $92,000\text{ N/C}$

□ Office hours...

MW 10-11 am

TR 9-10 am

F 12-1 pm

□ Tutorial Learning Center (TLC) hours:

MTWR 8-6 pm

F 8-11 am, 2-5 pm

Su 1-5 pm

Chapter 27

Gauss' Law

*(Conductors in Electrostatic
Equilibrium)*

Last time...

- *E*-field of a *infinite plane* of charge..

$$E_{plane} = \frac{\eta}{2\epsilon_0}$$

- *E*-field of a *sphere* (of radius R) of charge..

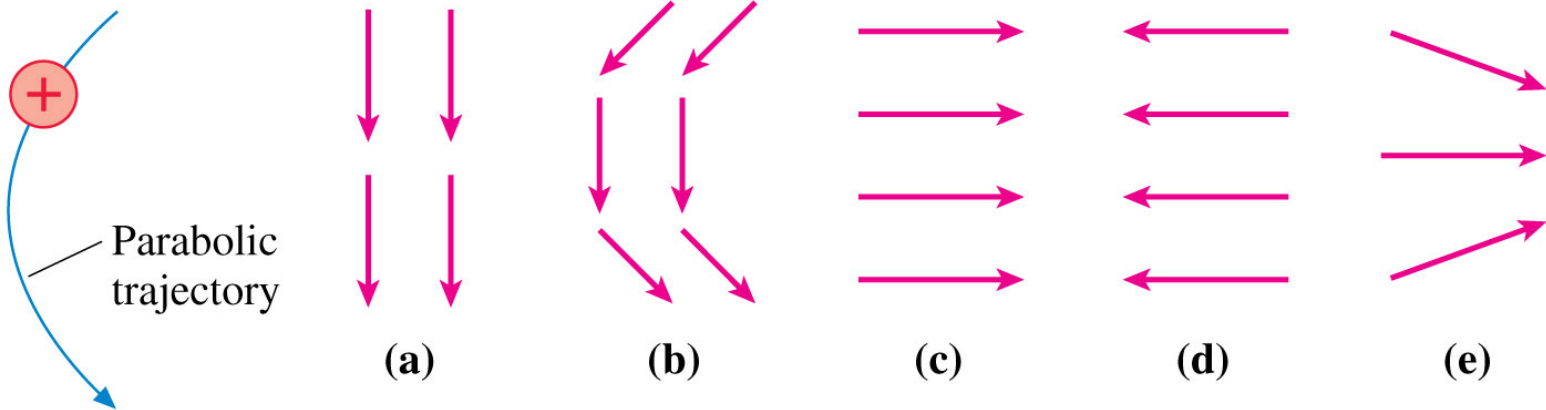
$$E_{sphere} = \frac{1}{4\pi\epsilon_0} \frac{Q}{r^2} \text{ for } r \geq R$$

- *E*-field of a *parallel-plate capacitor*..

$$\vec{E}_{cap} = \frac{\eta}{\epsilon_0}$$

Quiz Question 1

Which E -field is responsible for the proton's trajectory?



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1. (a)
2. (b)
3. (c)
4. (d)
5. (e)

i.e. 26.9:

Deflecting an e^- beam

An e^- gun creates a beam of e^- 's moving horizontally with a speed of 3.3×10^7 m/s. The e^- 's enter a 2.0 cm long gap between two parallel electrodes where the electric field is

$$E = -(5.0 \times 10^4 \text{ N/C}) \hat{j}.$$

In which direction, and by what angle, is the electron beam deflected by these electrodes?

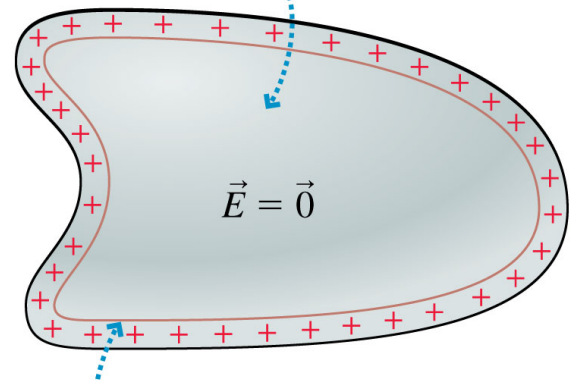
27.6:

Conductors in Electrostatic Equilibrium

Consider a charged conductor in *electrostatic equilibrium*...

- all charges are *stationary*.

The electric field inside the conductor is zero.



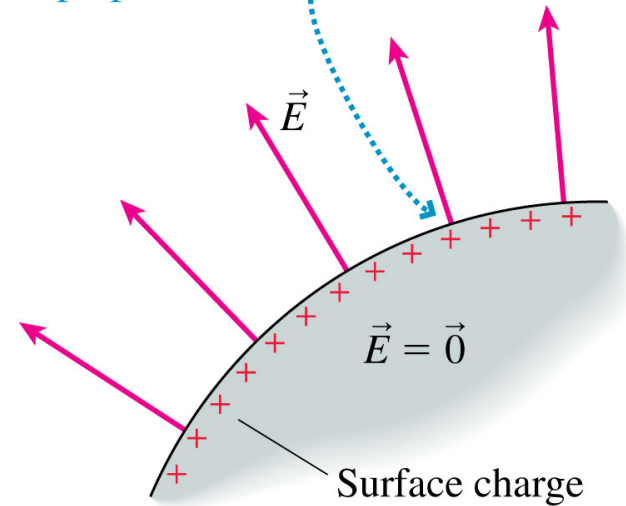
- E -field is ZERO at all points w/in the conductor.
- Any excess q resides on the *exterior surface*.

Conductors in Electrostatic Equilibrium

Consider a charged conductor in *electrostatic equilibrium*...

$$\vec{E}_{surface} = \frac{\eta}{\epsilon_0}, \perp \text{ to surface}$$

The electric field at the surface is perpendicular to the surface.



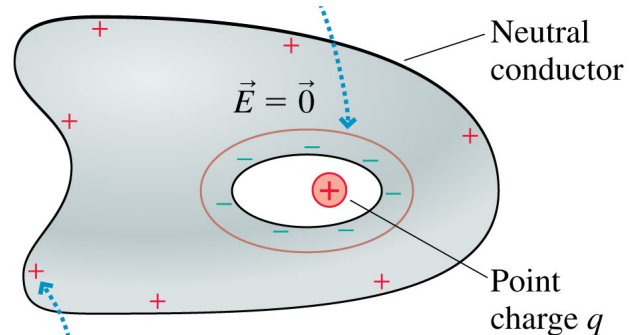
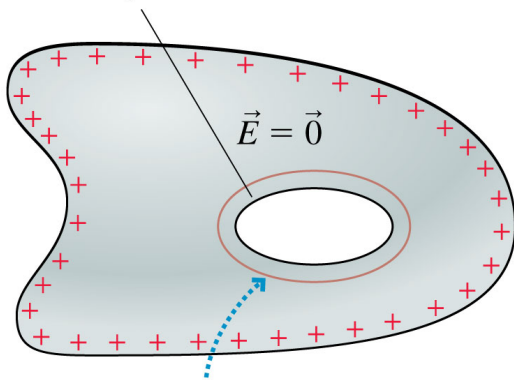
□ *E*-field at the surface of a charged conductor..

- is *perpendicular* to the surface.
- is of *magnitude* η/ϵ_0 , where η is the surface charge density *at that pt.*

Conductors in Electrostatic Equilibrium

Consider a charged conductor in *electrostatic equilibrium*...

A hollow completely enclosed by the conductor



The outer surface must have charge $+q$ so that the conductor remains neutral.

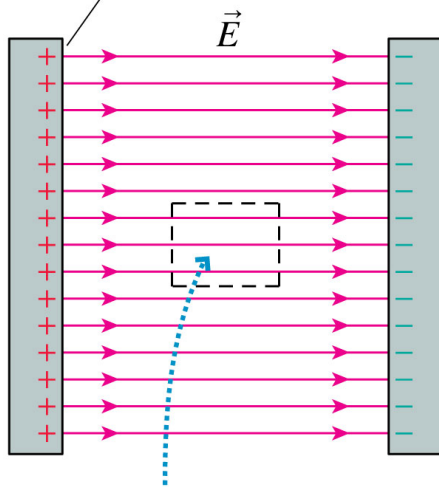
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- E -field is ZERO inside any hole w/in a conductor, *unless* there is a q in the hole.

Conductors in Electrostatic Equilibrium

Q: How can we exclude an E -field from some region?

(a) Parallel-plate capacitor



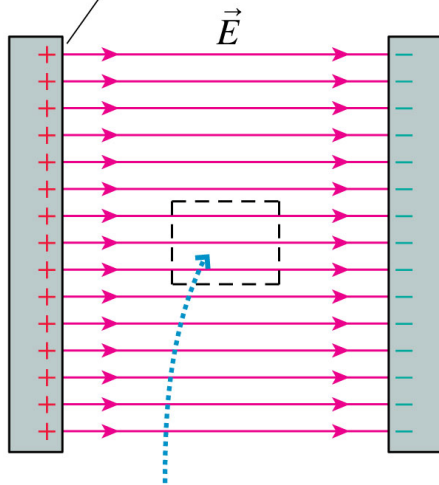
We want to exclude the electric field from this region.

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Conductors in Electrostatic Equilibrium

Q: How can we exclude an E -field from some region?

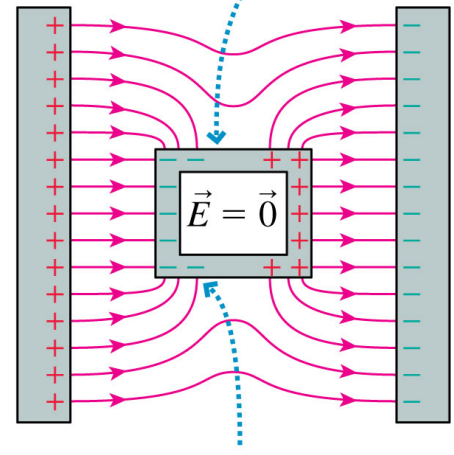
(a) Parallel-plate capacitor



We want to exclude the electric field from this region.

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(b) The conducting box has been polarized and has induced surface charges.



The electric field is perpendicular to all conducting surfaces.

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A: Insert a *neutral conducting box* (a.k.a. *Faraday cage*)

i.e. 27.7: The E -field at the surface of a charged metal sphere.

A 2.0 cm diameter brass sphere has been given a charge of 2.0 nC.

What is the E -field strength at the surface?

Quiz Question 2

A point charge q is located a distance r from the center of a neutral metal sphere. The E -field at the center of the sphere is

1. $\frac{q}{4\pi\epsilon_0 r^2}$
2. $\frac{q}{4\pi\epsilon_0 R^2}$
3. $\frac{q}{4\pi\epsilon_0 (R - r)^2}$
4. 0
5. It depends on the type of metal.

